NATIONAL BUREAU OF STANDARDS REPORT

9403

PERFORMANCE TEST OF AN

M-104 GLASS FIBER RENEWABLE FILTER MEDIA

Manufactured by

American Air Filter Company
Louisville, Kentucky

by

Charles M. Hunt

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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1. Introduction

At the request of the Public Buildings Service of the General Services Administration, performance characteristics of an M-104 roll filter media were determined. The scope of the investigation included determination of the arrestance of Cottrell precipitate diffused into laboratory air, and the nominal dust holding capacity when the face velocity was maintained at 500 ft/min. and the media was intermittently advanced in such a way as to maintain the pressure drop across the filter between 0.45 and 0.5 inches W.G.

2. Description of Test Specimen

The M-104 media was a white fiber glass mat about 2 inches thick. It was reinforced by longitudinal wires spaced about 10 inches apart which were cemented to its downstream side. The media was coated with adhesive. A section was found to have a weight of 35.3 grams per ft^2, and after three extractions with alcohol it had a dry weight of 15.6 grams per ft^2, indicating an adhesive content of 19.7 grams per ft^2. There was no visible evidence of drainage or excessive liquid on the media.

3. Test Methods and Procedure

The media was tested at a net face velocity of 500 ft/min. The arrestance determinations were made using the "NBS Dust Spot Method for Air Filters" (ASHVE Transactions, Vol. 44, p. 379, 1938). For the test, the roll of media was installed in a roll-filter frame constructed to fit the NBS test apparatus. This apparatus provided an airtight enclosure and adapters to fit the upstream and downstream sections of the test duct. This roll-filter frame has been used previously for testing various media of this type.

The frame had two openings, 2 ft x 2 ft, one upstream and the other downstream from the filter. The roll of filter media was placed at the top of the frame on a spool and arranged so the media passed immediately upstream of the downstream opening as it unrolled. The loaded media was rolled up on a similar spool at the bottom of the frame. The bottom spool was driven by a motor actuated manually when the pressure drop across the media reached 0.5 in.W.G. Nine vertical bars in the downstream opening served to prevent appreciable deflection of the media under the influence of the air pressure difference. The edges of the media were enclosed in metal groove-type tracks to restrict by-pass of air between the media and frame.

The frame and media were installed in the test duct and carefully sealed to prevent any by-pass of air or inward flow into the test apparatus, except through the measuring orifice. After establishing the correct air flow rate through the filter, samples of air were drawn from the center points of the test duct two feet upstream and eight feet downstream of the test specimen at equal rates and passed through known areas of Whatman No. 41 filter paper. The arrestance determinations were made with Cottrell precipitate injected into the air stream with a ratio of approximately one gram of dust per 1,000 cu ft of air.

The amount of light passing through the sampling papers was measured before and after the test on the same area of each paper, and the two sampling papers used for any one arrestance determination were selected to have the same light transmission when clean.

For determining the arrestance of the filter, different size areas of sampling paper were exposed upstream and downstream of the filter in order to obtain a similar increase of opacity on the two sampling papers. The arrestance was calculated by the formula:

$$A = \left(1 - \frac{S_D}{S_U} \times \frac{\Delta D}{\Delta D}\right) \times 100$$

where the symbols S_U and S_D are the upstream and downstream sampling areas and ΔU and ΔD are the observed changes in the opacity of the upstream and downstream sampling papers, respectively.

Arrestance determinations were made when the media was clean at the beginning of the test, and at selected intervals of loading until the intermittent advance of the media became representative of a steady-state operation. The arrestance determinations were made with Cottrell precipitate only, while cotton linters were added during the loading process in a ratio of 4 parts to every 96 parts of Cottrell precipitate. Each loading increment consisted of 20 grams Cottrell precipitate and 0.83 grams of cotton linters. The Cottrell precipitate had been previously sifted through a 100-mesh screen, and the lint was prepared by grinding No. 7 cotton linters through a large Wiley mill with a 4-millimeter screen.

The advance of the filter media was observed through a window in the test apparatus by determining the position of a marker, attached to the mat, relative to a scale mounted in the filter housing. The advance cycle, which was actuated by a manually operated switch, began when the pressure drop across the filter reached approximately 0.50 in. W.G. and stopped when the drop was about 0.45 in. W.G.

The position of the media at the beginning of each advance cycle was recorded as well as the corresponding cumulative dust load at the time of advance. From this information a plot was made of the advance of the media vs. dust load, and when the relation between the two parameters became very nearly linear, enough additional determinations of advance as related to load were made to develop the best-fitted straight line through the plotted data, from which the nominal dust-holding capacity in grams/ft^2 was determined.

The pressure drop across the media was recorded at the beginning of the test, at selected intervals during the dust loading process, and at the beginning and end of each advance cycle.

4. Test Results

The results of tests with the American Air Filter M-104 filter are summarized in Tables 1 and 2. From Table 1 an initial arrestance of 68 percent was calculated from the three initial values in the table. The average arrestance after steady state conditions were reached was estimated to be 81.4 percent. A final arrestance, not shown in the table, was obtained as fresh media was unrolled into the airstream. A value of 80.0 percent was obtained. From this it is concluded that very little dirt was dislodged into the airstream during movement of the filter.

Table 1

Performance of American Air Filter M-104 Roll-o-matic Filter Media at 2000 cfm

Total dust fed (grams)	Total advance of media (inches)	Pressure drop (inches W.G.)	Arrestance of Cottrell precipitate (percent)
0	0	0.180	69.0,69.4,64.1
262	0	0.358	75.0
433	0	0.505	81.4
791	15.3	0.498	81.6
1170	25.8	0.506	80.9
1465	34.3	0.506	81.2, 81.7

Table 2

Total Dust Fed, Advance of the Media, and Pressure Drop of American Air Filter M-104 Roll Filter Media Tested at 2000 cfm.

Total Dust Fed (grams)	Advance of [a] Media (inches)	Pressure Drop (inches W. G.) Before Advance	After Advance
0	0	0.180	----
116	0	.262	----
220	0	.330	----
433	0	.505	0.447
499	5.1	.500	.450
583	8.1	.510	.448
645	10.7	.498	.448
728	12.9	.508	.448
795	15.3	.504	.446
878	17.8	.502	.452
941	19.8	.500	.440
1024	21.8	.502	.450
1086	23.8	.500	.448
1170	25.8	.506	.450
1236	27.8	.498	.446
1320	30.3	.504	.450
1382	----	.500	.450
1465	34.3	.506	.450
1532	36.5	.502	----

a. The values in this column were taken just before advance to the next position.

Table 2 shows the advance of the filter media required to keep the pressure drop between 0.45 and 0.5 inches W.G. as dust was fed to the filter. The advance of the filter media is plotted in Figure 1 as a function of total dust fed, and a line is drawn through the points representing steady state conditions. Nominal dust holding capacity was calculated from the slope of the line by the relationship:

$$\text{Nominal dust holding capacity} = \frac{12}{SW},$$

where S is the slope of the line in inches advance per gram of dust load, and W is the width of the test duct where it meets the downstream side of the filter, which in this case is 2 ft. A nominal dust holding capacity of 213 grams per ft^2 was obtained. In Table 3 the average arrestance in the steady state and nominal dust holding capacity are compared with requirements for a type-E filter according to General Services Administration Air Conditioning Standard of December 1964.

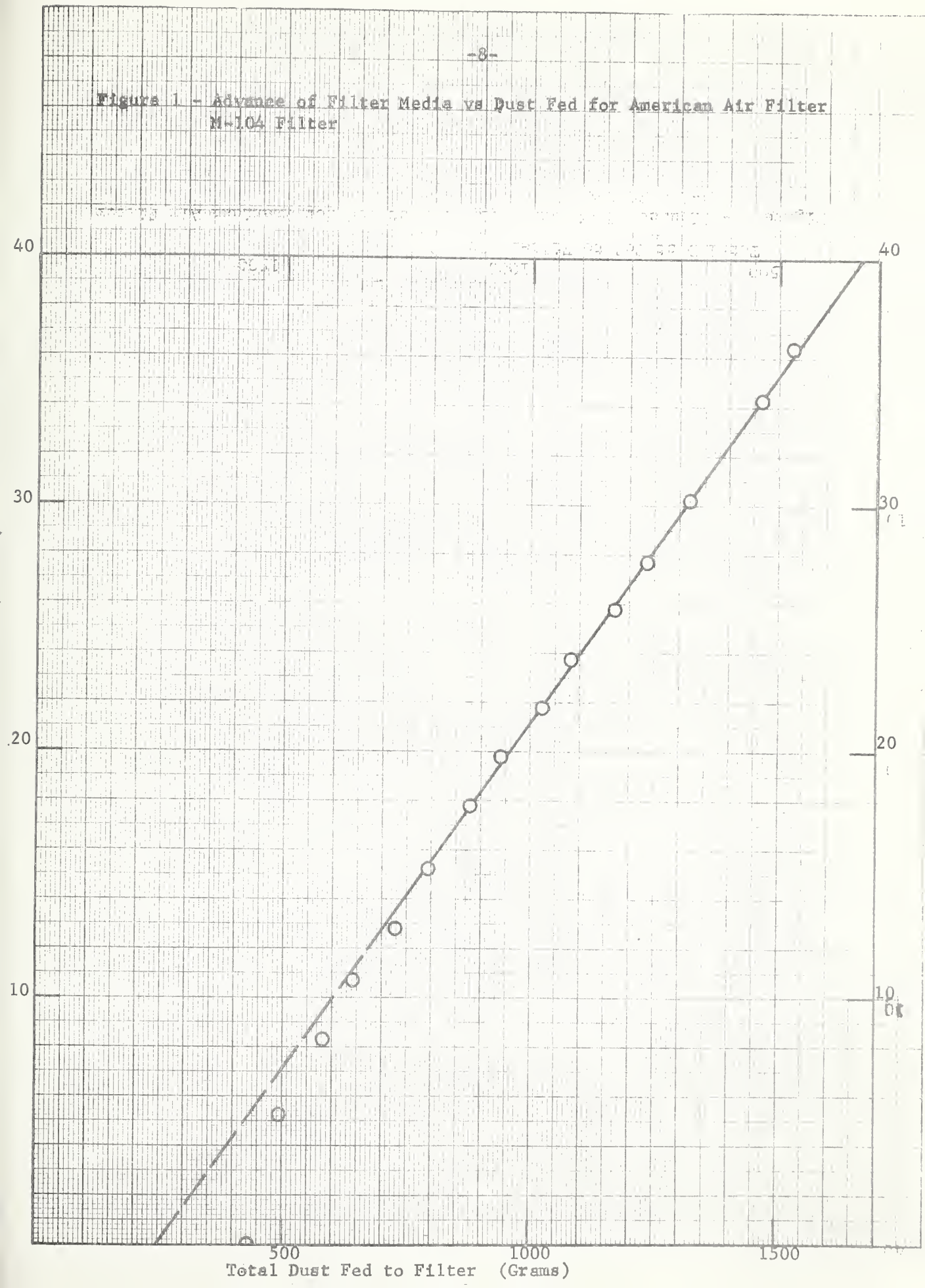
Table 3

Performance of American Air Filter M-104

renewable media compared with GSA requirements for a type-E filter.

	M104 media	Requirement type-E media
Nominal dust holding capacity (grams per square foot of media leaving the air stream)	213	200
Average arrestance of Cottrell precipitate in steady state (percent)	81.4	75

Figure 1 - Advance of Filter Media vs Dust Fed for American Air Filter M-104 Filter

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